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AIR QUALITY STUDIES
in the vicinity of
KIMBERLY-CLARK OF CANADA LIMITED
and WELDWOOD OF CANADA LIMITED
LONGLAC, ONTARIO.

Ontario
Ministry of the Environment

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LONGLAC, Ontario

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INTRODUCTION

A snow sampling survey was conducted in Longlac in February, 1983 near the Weldwood of Canada Limited waferboard and plywood mill, and the Kimberly-Clark of Canada Limited sawmill. This work was carried out in response to complaints of smoke and particulate fallout from these operations. The study revealed that the conical wood waste (teepee) burners operated at these plants were sources of airborne particulate matter.[1] Fallout levels in residential areas of Longlac were above normal but were not as high as those on company property near the teepee burners. No complaints of smoke or fallout have been received by the Ministry since the date of the 1983 survey.

To assess current levels of particulate fallout in Longlac, an air quality monitoring network comprising five dustfall jars and one high-volume air sampler was established in late 1983. The high-volume sampler was operated until the end of 1985 and dustfall measurements continued to the end of 1986. A follow-up snow sampling survey was carried out in early 1986.

METHODS

SNOW

Snow core samples were collected on February 13, 1986 from 16 sites around the teepee burners (Figure 1) and from two control sites remote from the study area. Most sampling sites were the same as those used in 1983; site 9 was deleted, and sites 19 and 20 were added to improve the geographical distribution of sampling locations in the townsite. Standard Ministry sampling procedures were followed.[2] Meltwater from the samples was submitted to the Ministry's Thunder Bay laboratory for determination of conductivity and pH. Analysis of carbon (total particulate carbon, dissolved organic carbon, dissolved

inorganic carbon) and solids (total solids, dissolved solids, suspended solids) was performed at the Ministry's Toronto laboratory. Ministry contaminant guidelines for snow are used in this report. Their exceedence would suggest that contamination may be present, but would not necessarily imply adverse effects.

DUSTFALL AND TOTAL SUSPENDED PARTICULATE MATTER

From 1984 to 1986, dustfall was measured at the five sites shown in Figure 2. Standard Ministry monitoring procedures were followed.[3] However, because of operating problems in the field, dustfall jars were sometimes exposed for 60-day periods, instead of the normal 30 days. From September, 1983 to December, 1985, total suspended particulate matter (TSP) was measured at station 63070 (Figure 2). A 24-hour sample was obtained every sixth day, following recommended Ministry sampling and analysis methods.[4]

RESULTS

SNOW SAMPLING

Trace to heavy quantities of wood fines and black particulate matter (wood and bark char) were noted on or below the snow surface at all sampling locations except at sites 8, 14, 16, 19, and at the control sites. Microscopic examination identified the particulate matter as primarily wood fibres, with minor amounts of partially combusted wood and bark. Sites free of visible particulate substances were all located off company property. Sample core depth averaged 46 cm (centimetres) and ranged from 20 to 73 cm.

Results of snow meltwater analysis are presented in Table 1, along with data from the 1983 survey. Contaminant guidelines for suspended solids and conductivity were significantly exceeded in both surveys at sampling sites on the two company properties.

Off-property concentrations of suspended solids sometimes moderately exceeded Ministry guidelines. The conductivity guideline was met at all off-property sites. While guidelines for carbon have not yet been established, the data indicate that carbon levels were above background concentrations on and off company property. Levels of carbon, solids, conductivity and pH were highest near the teepee burners and decreased as distance from these sources increased. Carbon and residues were distributed in a bi-modal pattern, similar to that shown in Figure 3 for suspended solids. Conductivity and pH, which did not show a bi-modal distribution, were highest near Weldwood's teepee burner. In 1986, levels of all parameters were higher than those recorded in 1983. These differences may be related to emission levels from the sources or to natural differences in the snow pack between 1983 and 1986.

The deposition rates of suspended solids in snow were calculated. According to data from the Geraldton weather station, snow was on the ground for 69 days in 1982-83 prior to our snow sampling dates. The comparable period for the 1986 survey was 87 days. On company property, deposition rates of suspended solids in snow were 1.2 to 2.1 $g/m^2/30$ days (grams per square metre per 30 days) near the Kimberly-Clark teepee burner in 1983 compared with 5.4 to 15.9 $g/m^2/30$ days in 1986. The large difference in fallout between 1983 and 1986 might be ascribed to differences in teepee burner operations; Kimberly-Clark's burner was only in use for 27 days prior to our 1983 survey, compared with 87 days in 1986. Near Weldwood, deposition rates varied from 2.1 to 5.4 $g/m^2/30$ days in 1983 and from 7.2 to 9.9 $g/m^2/30$ days in 1986. In residential areas in Longlac, deposition rates of suspended solids varied from 0.9 to 1.5 $g/m^2/30$ days. At the control sites, the rates were between 0.1 and 0.3 $g/m^2/30$ days. Deposition levels in the townsite and at the controls were similar in 1983.

Correlation matrices for snow meltwater chemistry are presented in Table 2. In 1986, a strong positive linear

relationship existed between all parameters tested, except for total particulate carbon and pH. These relationships suggest that all contaminants originated from a common source. The strong negative relationships between contaminants and distance from the teepee burners implicate the burners as sources of wood fines, as suggested in Figure 2. The stronger correlation between most contaminants and distances from Weldwood compared with Kimberly-Clark, suggests that the Weldwood burner is the larger emission source. The significant negative correlation between conductivity and pH with distance from Weldwood's teepee burner may be the result of burning wood wastes containing resin-based glues at Weldwood. These glues are used to manufacture plywood and waferboard products. Correlations of all parameters were generally similar in 1983 and 1986 (Table 2); correlation coefficients between contaminants and distances from Kimberly-Clark were, however, weaker in 1983 than in 1986, possibly because of the short period of teepee burner operations prior to the sampling in 1983.

DUSTFALL

Table 3 shows that monthly dustfall exceeded Ontario's maximum acceptable limit of 7 g/m²/30 d (grams of total dustfall per square metre during 30 days) 22 percent of the time from 1984 to 1986. Most of the exceedences occurred during the snow-free period at sites 63071 and 63074. The annual dustfall objective of 4.6 g/m²/30 d was exceeded during all three years at station 63071. Elevated dustfall was sometimes recorded at station 63074, the monitoring point farthest from the teepee burners. Particulate matter, such as road dust and biological material, likely contributed significantly to dustfall at this and other locations.

Microscopic examination of selected samples of insoluble dustfall showed that wood fibre, bark char and wood char accounted for less than 30 persent of total dustfall.

TOTAL SUSPENDED PARTICULATE MATTER (TSP)

At station 63070, there were only seven exceedences of the daily objective of 120 "g/m³ during 84 sampling periods from September, 1983 to December, 1985. The maximum value was 219 "g/m³. The annual objective of 60 "g/m³ was met in 1985 with an average of 32. The number of samples was too small to calculate annual means for 1983 and 1984.

CONCLUSIONS

The 1986 snow survey in Longlac confirmed that the Kimberly-Clark and Weldwood teepee burners were emission sources of airborne particulate carbon and wood fines. Snow contaminant guidelines were significantly exceeded on company property, and were occasionally slightly exceeded at off-property sites. Contaminant levels were higher in 1986 than in 1983.

Average dustfall and total suspended particulate matter sometimes exceeded provincial air quality objectives in the townsite. Exceedences were, however, not excessive and were mostly caused by non-industrial sources, such as road dust or biological matter.

Emissions from Weldwood's operations should be significantly reduced by the fall of 1986, when a fluidized-bed reactor will become operational. Start-up of this unit will result in much less use of the teepee burner. For economic reasons, Kimberly-Clark of Canada Limited closed its Longlac sawmill on May 15, 1987. A snow sampling survey will be carried out in 1988 to assess changes in local air quality as a result of these developments.

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4. Ontario Ministry of the Environment. 1979. Method of high volume sampling and determination of total suspended particulate matter in ambient air. Report AMP-101. Air Resources Branch.

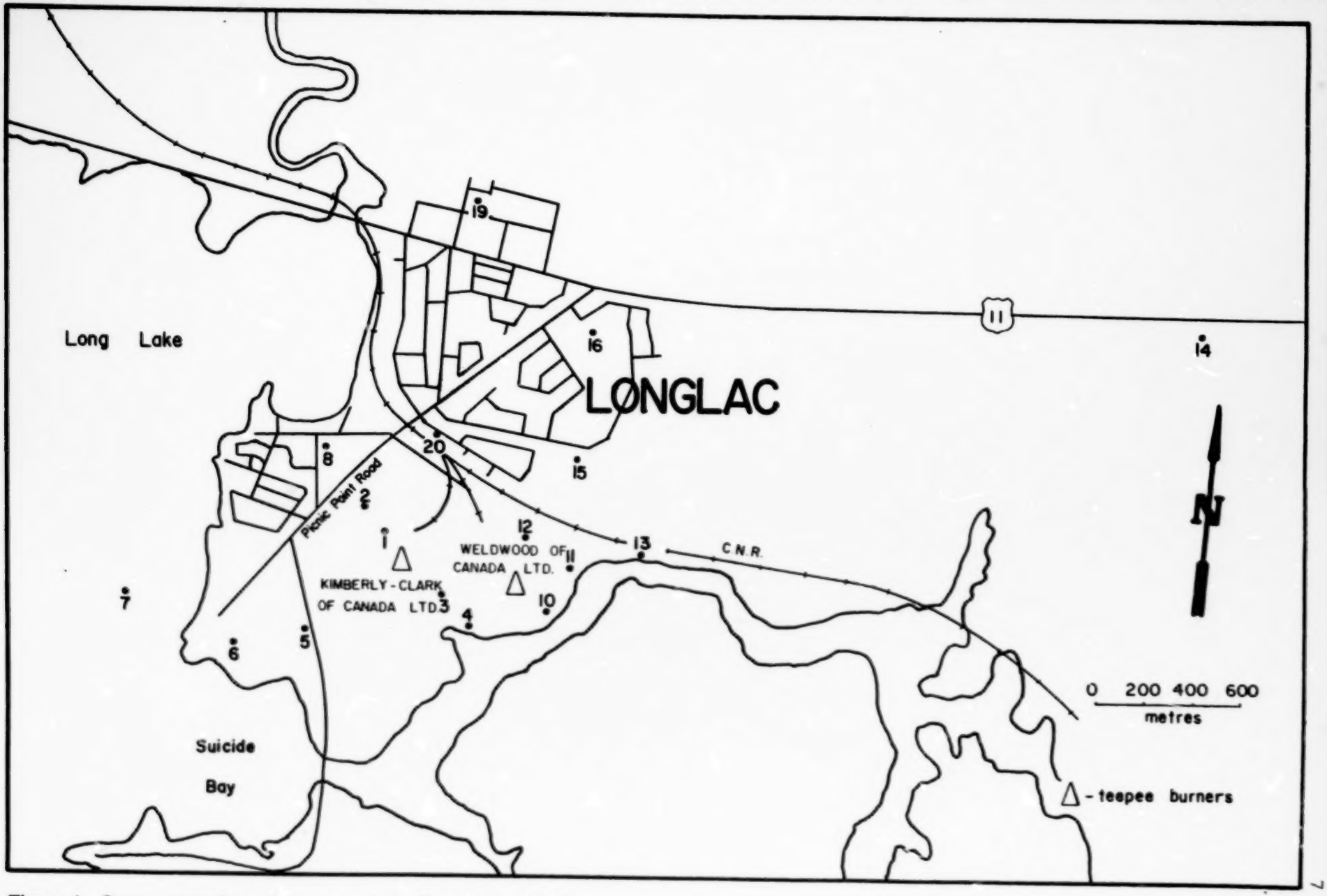

Figure 1. Snow sampling sites, Longlac, February, 1986.

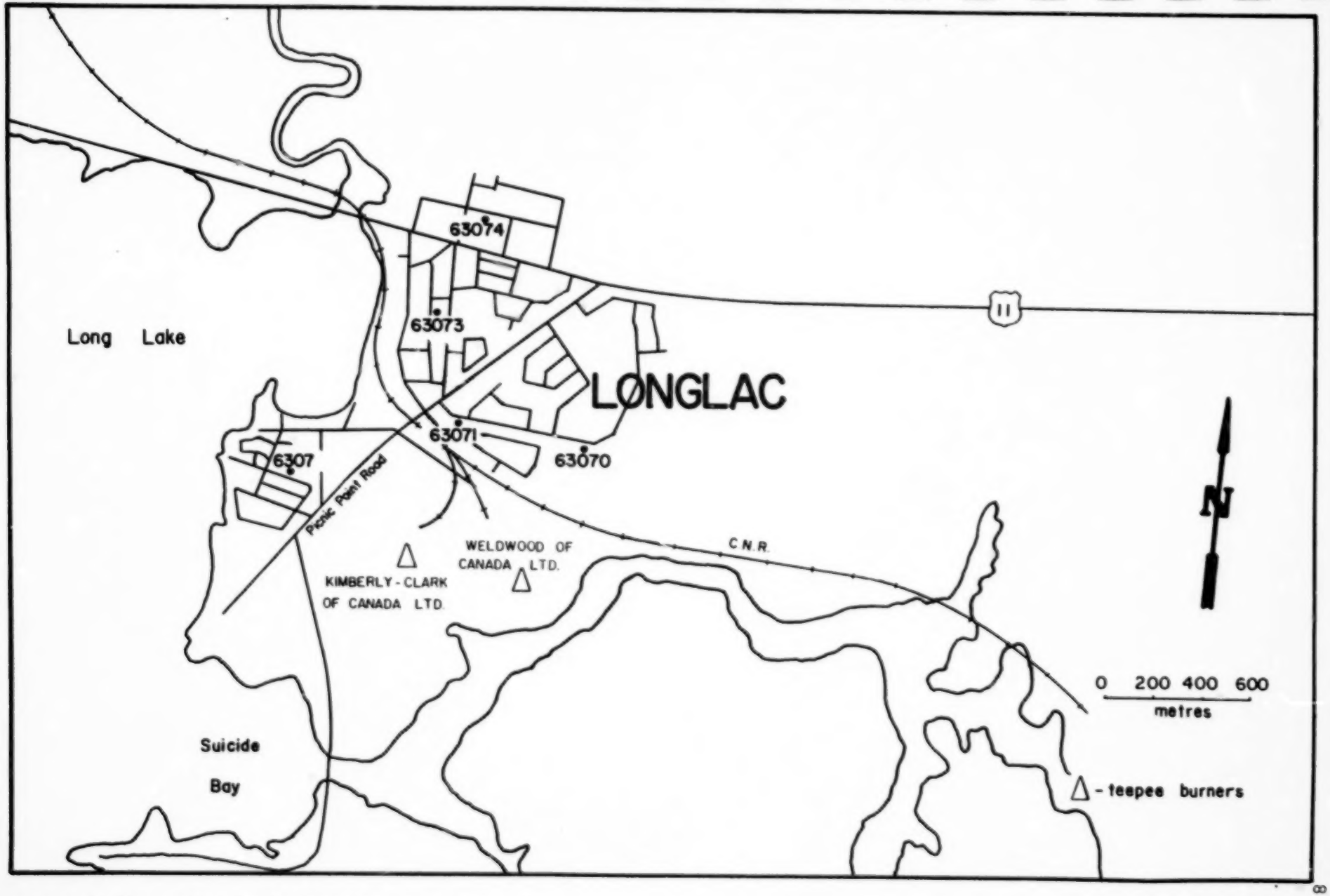

Figure 2. Air quality monitoring sites, Longlac.

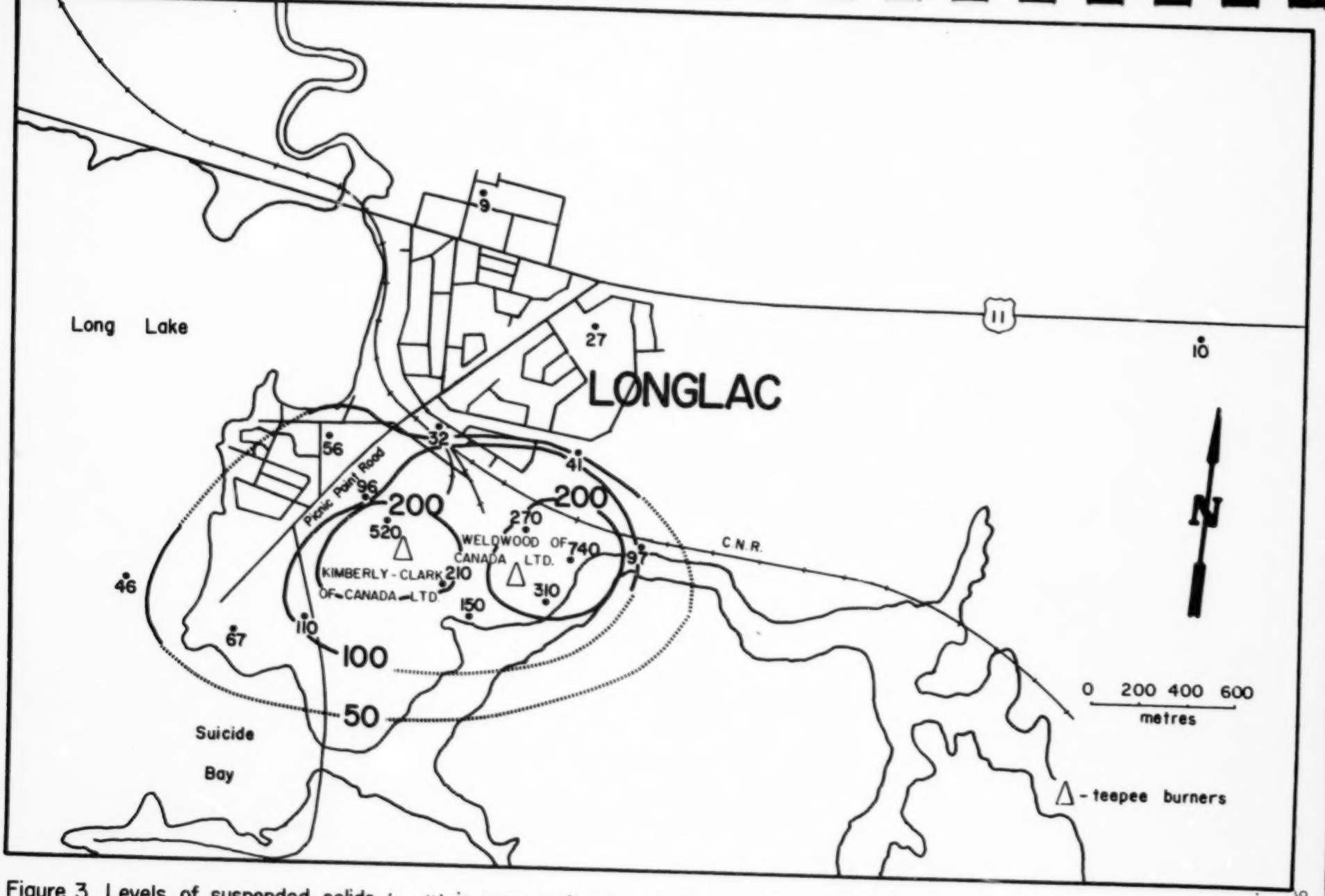

Figure 3. Levels of suspended solids (mg/l) in snow meltwater, Longlac, February, 1986.

TABLE 1. Comparison between levels of carbon, solids (mg/ℓ), conductivity (μmhos/cm) and pH in snow collected in the vicinity of Kimberly-Clark of Canada Limited and Weldwood of Canada Limited, Longlac, February 9, 1983, and February 13, 1986.

Site	Carbon						Solids				Conductivity		pH	
	Particulate		Dissolved inorganic		Dissolved organic		Suspended		Dissolved	Total				
	1983	1986	1983	1986	1983	1986	1983	1986	1986	1986	1983	1986	1983	1986
1	64	280	1.8	8.4	2.8	26.0	84	520	81	600	16	86	6.4	7.4
2	15	54	0.8	3.8	0.8	5.2	26	96	20	120	12	36	6.3	7.7
3	34	81	2.4	7.0	2.0	9.8	50	210	55	270	25	53	7.6	8.9
4	36	100	3.4	7.2	2.5	9.4	48	150	52	200	28	47	8.3	9.2
5	31	34	2.2	4.4	1.6	4.4	44	110	32	150	21	33	7.0	7.9
6	29	28	2.4	2.8	2.5	2.4	56	67	24	91	22	24	6.9	7.4
7[a]	12	14	<0.2	1.6	1.4	3.2	20	46	22	68	10	25	5.5	6.9
8[a]	8	30	1.0	2.6	0.8	2.0	16	56	22	78	13	21	6.4	7.1
9	68		6.6		8.9		140				84		10.0	
10	49	140	5.1	6.0	2.7	17.7	85	310	83	400	38	89	8.7	10.0
11	76	100	6.8	7.0	3.2	26.5	140	740	160	900	46	170	9.0	10.3
12	63	36	7.2	10.8	3.6	9.8	120	270	81	350	51	80	9.1	9.5
13	16	6	2.1	3.4	1.4	6.0	27	97	37	130	23	49	7.4	9.6
15[a]	21	11	2.4	3.0	1.7	2.8	36	41	26	67	24	26	6.8	8.2
16[a]	20	2	1.8	2.4	1.2	1.6	36	27	18	45	20	21	6.9	7.3
19[a]		18		1.4		1.1		9	14	23		18		6.9
20[a]		6		2.8		2.2		32	23	55		29		8.3
Controls[b]	<1	5	<0.2	0.8	0.3	0.6	3	6	6	12	8	16	5.2	6.2
Contaminant guidelines							30			60				

[a]Sites off company property.
[b]Averages of stations 14 and 17.

TABLE 2. Correlation matrix of selected parameters in meltwater from snow collected near Kimberly-Clark of Canada Limited and Weldwood of Canada Limited, Longlac, February 9, 1983 and February 13, 1986.

	Total particulate carbon		Suspended solids		Conductivity		pH	
	1983	1986	1983	1986	1983	1986	1983	1986
Suspended solids	.96*	.73*						
Conductivity	.73*	.57*	.86*	.96*				
pH	.75*	.19	.83*	.56*	.92*	.72*		
DIST-KC[a]	-.39	-.57*	-.27	-.40	-.14	-.31	-.20	-.28
DIST-WC[b]	-.70*	-.45	-.69*	-.61*	-.67*	-.68*	-.84*	-.87*

*Denotes a significant correlation for pairs of elements at the 95% confidence level.

[a]DIST-KC = Distance from sampling sites to the Kimberly-Clark of Canada Limited teepee burner.

[b]DIST-WC = Distance from sampling sites to the Weldwood of Canada Limited teepee burner.

TABLE 3. Total dustfall (g/m²/30 days), 1984-1986, Longlac.

Station	Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
		1984												
63070	Sewage Plant	9.4[a]	5.4	5.2	5.0	6.2	11.6	3.8	8.4	5.0[b]	5.0[b]	0.9	3.1	5.8
63071	130 Centennial Drive	3.9	6.3	6.7	7.3	9.2	11.9	10.9	9.9	9.9[b]	9.9[b]	2.5	3.9	7.7
63072	100 Poplar Street	1.9	1.2	3.1	5.0	10.1	3.9	17.4	6.2	9.9[b]	9.9[b]	3.4	3.7	6.3
63073	129 Dieppe Road	1.3	2.6	2.5	4.2	4.5	4.3	7.8	5.4	5.6[b]	5.6[b]	-	2.5	4.2
63074	129 Riverview Street	0.9	1.3	2.6	7.7	1.6	6.1	13.1	5.9	-	-	1.3	2.9	4.3
		1985												
63070	Sewage Plant	1.9	1.7	7.0	4.8	6.4	10.5	6.8	-	6.4	2.2	4.1	3.6	5.0
63071	130 Centennial Drive	2.5	1.7	8.8	7.4	8.9	14.6	8.9	9.1	6.1	5.3	-	2.3	6.9
63072	100 Poplar Street	3.4	-	2.5	5.9	6.4	-	-	6.1	5.9	2.2	-	0.9	4.2
63073	129 Dieppe Road	0.9	1.2	2.9	2.6	4.3	4.6	3.9	-	7.7	3.1	1.2	0.7	3.0
63074	129 Riverview Street	1.0	1.4	3.6	3.6	5.0	-	7.7	-	10.1	5.5	1.0	0.2	3.9
		1986												
63070	Sewage Plant	2.5	6.5	3.1	4.6[b]	4.6[b]	4.9	4.7	3.4[b]	3.4[b]	2.1	2.9[b]	2.9[b]	3.8
63071	130 Centennial Drive	2.4	5.0	7.2	8.6[b]	8.6[b]	10.3	8.8	6.2[b]	6.2[b]	5.6	4.2[b]	4.2[b]	6.4
63072	100 Poplar Street	1.6	1.8	4.6	6.3[b]	6.3[b]	11.1	7.1	4.6[b]	4.6[b]	1.7	2.0[b]	2.0[b]	4.5
63073	129 Dieppe Road	3.9	1.6	3.8	5.7[b]	5.7[b]	4.6	6.5	2.7[b]	2.7[b]	2.8	0.8[b]	0.8[b]	3.5
63074	129 Riverview Street	1.0	1.4	4.0	9.9[b]	9.9[b]	7.8	7.9	5.6[b]	5.6[b]	2.9	1.6[b]	1.6[b]	4.9

[a]Values exceeding maximum acceptable levels of 7.0 (monthly) or 4.6 (annual average) are underlined.

[b]Denotes a two-month exposure period.

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